JC14 Rec'd PCT/PTO 27 DEC 2001

°FORM PTO-1390 (REV 11-2000) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. § 371	449122020000
	U S. APPLICATION NO. (If known, see 37 CFR 1 5) 10/019062 ~~Not yet assigned~~

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE00/02132	June 30, 2000	June 30,1999

TITLE OF INVENTION

METHOD AND COMMUNICATIONS ARRANGEMENT FOR MATCHING TRANSMISSION RESOURCES BETWEEN A CENTRAL AND A NUMBER OF DECENTRALIZED COMMUNICATIONS DEVICES

APPLICANT(S) FOR DO/EO/US

Josef FROEHER et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - a. ☒ is attached hereto (required only if not communicated by the International Bureau).
   - b. ☒ has been communicated by the International Bureau.
   - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application under PCT Article 19 (35 U.S.C. 371(c)(2)).
   - a. ☒ is attached hereto.
   - b. ☒ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
   - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   - b. ☐ have been communicated by the International Bureau.
   - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   - d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A FIRST preliminary amendment.
14. ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☒ Other items or information: 1) Application Data Sheet; 2)Int'l Search Report; 3) IPER; 4) Return receipt postcard.

CERTIFICATE OF HAND DELIVERY

I hereby certify that this correspondence is being hand filed with the United States Patent and Trademark Office in Washington, D.C. on December 27, 2001.

Melissa Garton

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dc-293209

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U.S. APPLICATION NO (if known, see 37 CFR 1 5)	INTERNATIONAL APPLICATION NO	ATTORNEY DOCKET NO
Not yet assigned 10/019062	PCT/DE00/02132	449122020000

21. ☒ The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)):

CALCULATIONS PTO USE ONLY

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO $1,000.00

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO $860.00

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO $710.00

International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provision of PCT Article 33(1)-(4) $690.00

International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) $100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =				$860.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				$0	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	- 20 =		x $18.00	$0	
Independent claims	- 3 =		x $80.00	$0	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $270.00	$0	
TOTAL OF ABOVE CALCULATIONS =				$860.00	
☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by ½.				$0	
SUBTOTAL =				$0	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$0	
TOTAL NATIONAL FEE =				$0	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00 per property** +				$40.00	
TOTAL FEES ENCLOSED =				$900.00	
				Amount to be refunded:	$
				charged:	$

a. ☒ Please charge my **Deposit Account No. 03-1952** (referencing Docket No. 44912-20200.00) in the amount of $900.00 to cover the above fees. A duplicate copy of this sheet is enclosed.

b. ☒ The Commissioner is hereby authorized to charge any additional fees that may be required, or credit any overpayment to **Deposit Account No. 03-1952** (referencing Docket No. 44912-20200.00).

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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Description

2/prts

Method and communications arrangement for matching transmission resources between a central and a number of decentralized communications devices

In present-day communications networks based on the Asynchronous Transfer Mode - ATM - a number of decentralized communications devices, or a number of communication terminals which are each connected to the decentralized communications devices, are connected via a subscriber access network to a higher-level ATM communications network. The subscriber access network may, for example, be configured, on the basis of a point-to-multipoint configuration as a passive optical network - also referred to as PON - by means of glass fibers. No active optical or electrical components - such as amplifiers or multiplexers - are required to produce a passive optical network, and no power supply is required within these networks, either. A central point can access the subscribers connected to it by means of passive optical splitters - which are also referred to as combiners. Special active devices for termination of the optical transmission path are arranged at each of the end points of the glass fibers, with an optical line termination "OLT" - also referred to as an optical network monitoring unit in the following text - generally being provided at the central point, and further optical network units "ONU" - also referred to as optical network termination units in the following text - generally being provided at the decentralized point. The information is transmitted via the passive optical network either in separate directions by means of two glass fibers, or else via a single glass fiber using a wavelength-division multiplex method.

Passive optical networks are known to those skilled in the art from the ITU Specification ITU-T G.983.
The access by the network termination units, and by the

communications terminals which are connected to the network termination units, via the jointly used transmission medium to the higher-level ATM communications network is controlled by an access algorithm, which is normally in the form of hardware when the transmission speeds are high and when a large number of communications terminals are connected. The access algorithm is used to grant access authorization and access to the jointly used transmission medium to a network termination unit requesting communications network resources. Instead of communications units, lower-level communications networks - for example local area networks or LANs - can also be connected to the higher-level ATM communications network via the jointly used communications network.

The document "NOVEL ALGORITHM FOR TIME DIVISION MULTIPLE ACCESS IN BROADBAND ISDN PASSIVE OPTICAL NETWORKS, International Journal of Digital and Analog Communication Systems, VOL. 6, pages 55 to 62 (1993), M. Glade and H. Keller", for example, describes a method for controlling access by network termination units to predetermined resources in a subscriber access network in the form of a passive optical communications network. According to the disclosed method, a timer or counter is provided for each network termination unit, in a network monitoring unit which is arranged centrally in the subscriber access network and is connected to each network termination unit, and the timers or counters are started during the processes for setting up connections derived from the network termination units. A timer times out, or the counter reaches a predetermined value, as soon as a new data packet or a specially reserved memory area is filled with user data in a relevant network termination unit, and is temporarily stored, for data transmission, in a buffer store which is likewise located in the network termination unit. The design of the counters which are arranged in the network monitoring unit, or the definition of the time at which a timer times out is

dependent on the respective data transmission rates defined or reserved in each case while setting up connections. A signalling signal which indicates that a timer has timed out represents a network termination unit-specific request for transmission authorization or access to the jointly used transmission medium, which is stored sequentially in a memory - for example a FIFO memory - which is used jointly by all the network termination units connected to the network monitoring unit and is located in the network monitoring unit. The stored access requests are read from this memory and are transmitted as an actual transmission authorization to the connected network termination units or communications terminals, as a result of which access is granted to the jointly used transmission medium. In the described method, for example, two timers may time out at the same time, that is to say two simultaneous access requests may need to be stored and controlled. However, since two simultaneous accesses are impossible, one of the two access requests is delayed until the actual access by the other access request has been completed. This delay is referred to as the "cell delay variation". If a number of timers time out at the same time, the value of the "cell delay variation" is increased appropriately.

In the communications technology based on the Asynchronous Transfer Mode, a number of ATM traffic types - also referred to as ATM service classes or available services - are known, which have been defined by the ATM forum and by means of which data links and high-bit-rate data transmission with different requirements, for example, for the transmission bandwidth and delay times are supported and/or provided. Voice, images and data, for example, can be transmitted in ATM communications networks, using ATM connections, which each have a guaranteed transmission quality and/or transmission characteristics, via the same subscriber connections using a type of cell multiplexing method. The following ATM traffic types -

also referred to as ATM service classes in the following text - which have been defined by the ATM forum should be mentioned, by way of example:

- "Constant Bit Rate" (CBR),
- "Variable Bit Rate - real time" (VBRrt),
- "Variable Bit Rate - non real time" (VBRnrt),
- "Guaranteed Frame Rate" (GFR),
- "Unspecified Bit Rate" (UBR), and
- "Available Bit Rate" (ABR).

When setting up an ATM link, the respective ATM traffic parameters which represent the quality and/or the transmission characteristics of the ATM links, and the quality of service - also referred to as the quality of service parameter or QoS parameter - are negotiated in the course of a CAC - Connection Admission Control - process for the desired ATM traffic types, and are defined in what is referred to as a traffic contract. Examples of ATM traffic parameters include "Peak Cell Rate, PCR", "Sustainable Cell Rate, SCR" and "Minimum Cell Rate, MCR". Examples of QoS parameters include "Cell Delay Variation, CDV", "Cell Transfer Delay, CTV", and "Cell Loss Ratio, CLR".

The ATM service classes CBR and VBR are particularly suitable for applications with stringent QoS requirements, such as multimedia services or videoconference circuits with high-quality video transmission. Constant Bit Rate CBR allows data transmission at a constant transmission speed, and constant, very short delay times, with the required bandwidth being characterized by quoting a peak cell rate PCR which must be provided throughout the entire duration of the connection.

When setting up ATM connections in the ATM service class VBR, peak and minimum transmission rates are negotiated between the ATM communications network and the respective communications terminal. In this

category, a distinction is drawn between real time "VBRrt) and non-real-time requirements (VBRnrt). The ATM service class VBRrt places similarly stringent requirements on the cell delay and the variation in the cell delays as the ATM service class CBR, while only a certain upper limit need by complied with for the ATM service class VBRnrt.

In the case of connections which are based on the ATM service class ABR, although a minimum transmission speed is agreed, the best-possible transmission speed is, however, always used, if possible.

The ATM service class UBR represents a quality of service in which, in contrast to CBR and VBR, no fixed bandwidth is reserved, and no cell loss rate CLR is defined, either. When a UBR connection is to be set up or is desired, no demands whatsoever are placed on the connection and, hence, no transmission quality whatsoever is guaranteed by the communications network.

The ITU-T Specification I.356 "B-ISDN ATM Layer Cell Transfer Performance" describes the breakdown of the QOS classes defined by the ATM forum into a stringent class (Class 1) and into non-stringent classes (Class 2, Class 3, U Class).

The invention is based on the object of achieving effective utilization of the transmission resources provided by the transmission medium when a number of connections, in particular ATM connections, are routed via a jointly used transmission medium - for example a passive optical network (PON). Against the background of a method and of a communications arrangement, the object is achieved in accordance with the features of the precharacterizing clause of patent claims 1 and 19, by the characterizing features in these claims.

In the method according to the invention for matching transmission resources between a central and a number

of decentralized communications devices, the central communications device allocates to each of the decentralized communications devices a transmission resource element as a function of the quality and/or the transmission characteristics of at least one connection which is routed via the respective transmission resource element. The major aspect of the method according to the invention is that the transmission resource elements which are allocated to the decentralized communications devices are at least partially reduced, and the quality and/or transmission characteristics of the at least one connection which is routed via the respective reduced transmission resource element is determined. The extent of the reduced transmission resource element which is allocated to each decentralized communications device is modified or retained as a function of the quality and/or the transmission characteristics.

The major advantage of the method according to the invention is that flexible matching of the transmission resources provided by a jointly used transmission medium makes it possible to increase the traffic throughput via the transmission medium and to effectively utilize the transmission resources of the jointly used transmission medium. The at least temporary allocation of transmission capacities in the transmission medium which are reserved but are not currently used results in an improved "burst response" in, for example, "passive optical networks".

The transmission resources which become free as a result of at least partial reduction of the allocated transmission resource elements advantageously result in other decentralized communications devices being made available, at least temporarily - claim 2. The effective utilization, obtained in this way, of the transmission resources provided by the transmission medium makes it possible to increase the number of subscribers connected to the transmission medium,

and/or the number of connections routed via the transmission medium, while retaining the transmission quality for all the connections.

According to a further advantageous refinement, the at least one connection which is routed via the respective allocated transmission resource element is implemented using Asynchronous Transfer Mode ATM, with the ATM connection being configured in accordance with a standardized ATM service class, which in each case specifies the quality and the transmission characteristics of the ATM connection, the information to be transmitted using an ATM connection is stored in at least one queue in each decentralized communications device. The current queue filling level of the at least one queue is recorded and subsequently, by assessing the recording result, the quality and the transmission characteristics of the respective ATM connections are determined, and the allocated transmission resource element is modified as a function of the quality and of the transmission characteristics - claim 4. The use of the method according to the invention for ATM connections using the Asynchronous Transfer Mode advantageously makes it possible for the queues or ATM cell buffers arranged in the decentralized communications devices to be designed to be less extensive, while also reducing the delay times for ATM cells passing through the decentralized communications devices. The use of the respective queue filling levels for assessing the quality and the transmission characteristics of the respective ATM connections makes it possible for the method according to the invention, in particular when using the communications networks based on the Asynchronous Transfer Mode ATM, to be designed to be particularly simple and hence economic.

Advantageously, when a number of ATM connections are routed via one decentralized communications device, the queue filling levels of the queues are recorded and assessed as a function of the ATM service class of the

respective ATM connections - claim 6. An ATM service class specific sum of the queue filling levels of the corresponding queues is formed for each ATM service class, with the ATM service class specific queue total filling level information which is formed being weighted as a function of the ATM service classes. The assessment of the weighted, ATM service class specific queue total filling level information makes it possible to determine the quality and the transmission characteristics of the ATM connections in an ATM service class on an ATM service class specific basis in each case, and to modify the transmission resource element, which is allocated to the decentralized communications device, as a function of the quality and the transmission characteristics - claim 8. This advantageous ATM service class specific assessment of the quality and transmission characteristics of ATM connections in an ATM service class makes it possible to allocate the transmission resource elements of a jointly used transmission medium optimally and, in particular in the case of communications networks based on the asynchronous transfer mode ATM, to achieve optimum, that is to say effective, use of the "upstream PON transport quality", taking account of compliance with the ATM quality features.

Further advantageous refinements of the method according to the invention can be found in the further claims.

The method according to the invention will be explained in more detail in the following text with reference to two drawings, in which:

Figure 1 shows a large number of communications terminals which are connected to a higher-level communications network via a jointly used transmission medium in the form of a "passive optical network", and

Figure 2 shows an example of a scenario of ATM connections which are currently routed via an optical network termination unit which is connected to the "passive optical network", and correspondingly arranged connection specific queues, which are read as a function of the transmission resource element which is allocated to each optical network termination unit for the transmission of information.

Figure 1 shows, in the form of a block diagram, a subscriber access network ACCESS via which a large number of communications terminals KE1…z, which are each allocated a subscriber, are connected to a higher-level communications network OKN. In this exemplary embodiment, the subscriber access network ACCESS is in the form of a passive optical network PON in a point-to-multipoint configuration. The central component of the passive optical network PON is an optical network monitoring unit OLT which, for example, is connected via an optical waveguide LWL to predetermined transmission resources vr in the higher-level communications network OKN. The higher-level communications network OKN is designed using the asynchronous transfer mode ATM, with the predetermined resources vr in the higher-level ATM communications network OKN having a data transmission rate of, for example, 155 Mbit/s. The optical network monitoring unit OLT is connected via a number of glass fibers and via a passive optical splitter - which is also referred to as a combiner - to three optical network termination units ONU1…3, with the jointly used "passive optical network" PON transmission medium being terminated by the three optical network termination units ONU1…3 and by the optical network monitoring unit OLT.

The three optical network termination units ONU1…3 are connected to a total of z communications terminals KE1…z, in which case each communications terminal KE1…z

can access the predetermined resources vr in the ATM communications network OKN. The request for resources can, for example, be produced administratively as part of the network management function or by means of package-oriented transmission protocols - for example, TCP/IP - by transmitting an appropriate connection set-up message from a communications device KE1…z to the corresponding optical network termination unit ONU1…3. The respective optical network termination unit ONU1…3 then initiates the process of setting up a connection in an appropriate manner and in accordance with the protocol to the optical network monitoring unit OLT, and from there to the higher-level ATM-oriented communications network "OKN". In the course of setting up a connection, corresponding, ATM connections are then allocated to the respective optical network termination unit ONU1…3 and to the respective communications terminal KE1…z.

The ATM forum has defined various ATM service classes, with each ATM connection associated with an ATM service class being specified by its specific ATM traffic parameters and QoS parameters. For example, ATM connections in the "Constant Bit Rate, CBR" service class and in the "Variable Bit Rate - real time, VBRrt" service class, have a specific "Peak Cell Rate, PCR" as the guaranteed data transmission rate - also referred to as the "guaranteed minimum transmission capacity". ATM connections in the "Variable Bit Rate - non real time, VBRnrt" ATM service class have a specific "Sustainable Cell Rate, SCR", and ATM connections in the "Guaranteed Frame Rate, GFR" ATM service class and in the "Available Bit Rate, ABR" ATM service class have a specific "Minimum Cell Rate, MCR" as the guaranteed data transmission rate.

The optical network monitoring unit OLT controls the access by the individual optical network termination units ONU1…3 to the jointly used "Passive Optical Network" PON transmission medium as a function of the

ATM connections which are allocated to each optical network termination unit ONU1…3, or as a function of the respective ATM service class of the associated ATM connections. To this end, the optical network monitoring unit OLT contains an access control unit MAC which is used to define, at the ATM-MAC layer - Medium Access Control - level, and on the basis of the various ATM traffic parameters and QoS parameters which specify the individual ATM connections, what the optimum sequence is for the three optical network termination units ONU1…3 to access the jointly used "Passive Optical Network" PON transmission medium for information transmission in the upstream direction.

The transmission of access information - also referred to as "grants" -, which controls the access to the jointly used "Passive Optical Network" PON transmission medium, from the optical network monitoring unit OLT to the connected optical network termination units ONU1…3 is described in more detail in the ITU-T Specification G.983. This will not be described in any more detail.

For this exemplary embodiment, it is assumed that the jointly used "Passive Optical Network" PON transmission medium has specific transmission resources rpon, which are oriented for time division multiplexing, and that the three optical network termination units ONU1…3 are each allocated with transmission resource elements from the time-division-multiplex-oriented transmission resources rpon, as a result of which the three optical network termination units ONU1…3 are allocated access to the "Passive Optical Network" PON using a TDMA access method. It is also assumed that a different number of ATM connections are routed through the "Passive Optical Network" PON via the three optical network termination units ONU1…3.

First time-division-multiplex-oriented resource elements tpr1 in the passive optical network PON are allocated to the first optical network termination unit

ONU1 and second time-division-multiplex-oriented resource elements tpr2 are allocated to the second optical network termination unit ONU2, and third time-division-multiplex-oriented resource elements tpr3 are allocated to the third optical network termination unit ONU3, for transmission of information in the upstream direction, as a function of the ATM traffic parameters and the QoS parameters of the respectively associated ATM connections - controlled by the optical network monitoring unit OLT. The assignment of time-division-multiplex-oriented resource elements tpr1...3 by the optical network monitoring unit OLT is also referred to as "grant generation".

The control, according to the invention, of the access by the optical network termination units to the jointly used transmission medium PON will be explained in more detail in the following text. To this end, by way of example, Figure 2 shows the actual connection situation at a specific time for ATM connections which are routed via one of the optical network termination units ONU1...3 which are illustrated in Figure 1, to the higher-level ATM communications network OKN. As shown in Figure 2, three ATM connections vCBR1...3 in the stringent class CBR are routed via the illustrated optical network termination unit ONU1...3, in accordance with the ITU-T Specification I.356. Furthermore, an ATM connection vVBRrt in the ATM service class VBRrt, x ATM connections vVBRnrt1...x in the ATM service class VBRnrt, y ATM connections vGFR1...y in the ATM service class GFR and one ATM connection in the ATM service class vUBR are routed via the optical network termination unit ONU1...3.

The information or ATM cells which are transmitted by those communications terminals KE1...n, KEn+1...m, KEm+1...z which are connected to the optical network termination unit ONU1...3 in the upstream direction using the three stringent ATM connections vCBR1...3 are temporarily stored in a first queue WS1, which is used jointly by

the ATM connections in the ATM service class CBR, with the respectively temporarily stored ATM cells being read from the first queue WS1 in accordance with the FIFO principle. The ATM cells which are transmitted via the ATM connection vVBRrt are temporarily stored in a second queue WS2. Furthermore, the ATM cells in the x ATM connections vVBRnrt1...x in the ATM service class VBRnrt are in each case temporarily stored in a third to k-th queue WS3...k, and the ATM cells in the y ATM connections vGFR1...y in the ATM service class GFR are in each case temporarily stored in an l-th to m-th queue WS1...m. ATM cells for the ATM connection vUBR in the ATM service class UBR are temporarily stored in an n-th queue WSn. In contrast to ATM connections in the ATM service class CBR, a connection-specific queue WS2...n is provided in the optical network termination unit ONU1...3 for each ATM connection in the tolerant ATM service classes, that is to say for ATM connections in the ATM service classes VBRrt, VBRnrt, UBR, GFR.

The queues for ATM connections in a tolerant ATM service class VBRrt, VBRnrt, UBR, GFR are read using the weighted fair queuing algorithm - also referred to as a WFQ scheduler. In the WFQ scheduler, the respective queues WS2...n are read in a weighted manner as a function of the ATM service class VBRrt, VBRnrt, UBR, GFR for the respective ATM connection. The weighting factor for the respective queues WS1...n which are arranged in an optical network termination unit ONU1...3 can be configured as required, with the weighting factors being derived by a control unit STG, which is arranged in the optical network termination units ONU1...3, as a function of the ATM traffic parameters - PCR, SCR, MCR - and the QoS parameters - CDV, CTD, CLR - of the respective ATM connections vCBR1...3, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR which are routed via the optical network termination unit ONU1...3 at that time. The WFQ scheduler is subordinate to an absolute delay priority algorithm - also referred to as an ADP scheduler -, by means of which the queue of ATM

connections in the stringent class - in this case WS1 - is read with priority.

The transmission resource elements tpr1...3 which are allocated to an optical network termination unit ONU1...3 in the passive optical network PON, as well as the weighting factors for the queues WS1...n which are arranged in the optical network termination units ONU1...3 are configured in the normal way such that all the guaranteed transmission capacities are complied with for those ATM connections vCBR1...3, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR which are routed via the respective optical network termination unit ONU1...3. According to the invention, the transmission resource elements tpr1...3 which are respectively allocated to the individual optical network termination units ONU1...3 are reduced, on an ATM service class specific basis, by the access control unit MAC which is arranged in the optical network monitoring unit OLT, such that only a portion of the sum of the guaranteed minimum transmission resources of the ATM connections vCBR1...3, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR which are routed via the respective optical network termination units ONU1...3 is still covered by the resource elements tpr1...3 which are allocated to the individual optical network termination units ONU1...3, and which are now reduced. In this way, the transmission resource which has in consequence become free in the upstream direction in the passive optical network PON can be used flexibly by other optical network termination units ONU1...3 for transmitting ATM cell bursts.

According to the invention, in order to provide central monitoring for the ATM traffic parameters and the QoS parameters of the respective ATM connections vCBR1...3, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR which are routed via an optical network termination unit ONU1...3, the current filling levels fs1...n of the queues WS1...n which are arranged in each optical network termination unit ONU1...3 - and which are also referred to as "ONU output

queues" - are transmitted to the optical network monitoring unit OLT. The checking of the current queue filling levels fs1…n of the queues WS1…n pointing in the upstream direction in an optical network termination unit ONU1…3 is carried out on a fixed time pattern by the optical network monitoring unit OLT. In this case, the transmission of the current queue filling levels fsl…n of all the connected optical network termination units ONU1…3 in a passive optical network PON specified in accordance with ITU-TG.983 is requested by the optical network monitoring unit OLT by means of PLOAM cells - Physical Layer Operation/Administration and Maintenance Cells. In response, the respective optical network termination units ONU1…3 transmit corresponding queue filling level information fs1…n, which represents the current queue filling levels, to the optical network monitoring unit OLT using specific minicells - which are also referred to as minislots.

The queue filling level information fs1…n for the queues WS1…n which are arranged in an optical network termination unit ONU1…3 are advantageously transmitted on an ATM service class specific basis, that is to say the sum of the filling levels - referred to as ifs_CBR, ifs_VBRrt, ifs_VBRnrt, ifs_GFR, ifs_UBR in Figure 2 - of ATM connections vCBR1…3, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR and of queues for each ATM service class CBR, VBRrt, VBRnrt, GFR, UBR is in each case formed in the respective optical network termination unit ONU1…3, and is transmitted to the optical network monitoring unit OLT. By way of example, as shown in Figure 2 for the ATM service class VBRnrt, the sum of the filling levels of the third to k-th queues WS3…k - in this case ifs_VBRnrt = Σ fs3…k - and the sum of the filling levels of the 1-th to m-th queues WS1…m - in this case ifs_GFR = Σ fs1…m - is formed and is transmitted to the optical network monitoring unit OLT. In the case of queues - not illustrated in Figure 2 - which are set up for virtual connections VC, the sum of the filling levels of the respective queues associated with each

virtual connection is advantageously transmitted.

A first, upper ATM service class specific queue total filling level limit value $x_{HIGH}1 \ldots s$ is provided, and is stored, for each associated ATM service class CBR, VBRrt, VBRnrt, GFR, UBR in the optical network monitoring unit OLT. ATM service class specific queue total filling level information ifs_CBR, ifs_VBRrt, ifs_VBRnrt, ifs_GFR, ifs_UBR, which is transmitted from the three optical network termination units ONU1…3 to the optical network monitoring unit OLT, is permanently compared with these stored, ATM service class specific queue total filling level limit values $x_{HIGH}1 \ldots s$. According to the invention, the access controller MAC which is arranged in the optical network monitoring unit OLT is designed such that the three optical network termination units ONU1…3 access the passive optical network PON

- as a function of the ATM service class of the respective ATM connections vCBR1…3, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR which are routed via the optical network termination units ONU1…3, and
- as a function of the comparison results of the transmitted, ATM service class specific queue filling level information ifs_CBR, ifs_VBRrt, ifs_VBRnrt, ifs_GFR, ifs_UBR with the stored queue total filling level limit values $x_{high}1 \ldots s$.

The following ATM traffic parameters are relevant for controlling the access to the passive optical network PON for the respective ATM service classes:

- the traffic parameter "Peak Cell Rate (PCR)" for ATM connections in the ATM service classes CBR and VBRrt,
- the ATM traffic parameter "Sustainable Cell Rate (SCR)" for ATM connections in the ATM service class VBRnrt "Sustainable Cell Rate (SCR)", and
- the ATM traffic parameter "Minimum Cell Rate (MCR)" for ATM connections in the ATM service class GFR.

If the access control unit MAC which is arranged in the optical network monitoring unit OLT finds that one of the first upper ATM service class specific queue total filling level limit values $x_{HIGH}1...s$ which are stored in the optical network monitoring unit OLT has been exceeded for one of the connected optical network termination units ONU1...3, then the access control unit MAC once again increases the transmission resource element tpr1...3, which is allocated to a reduced extent in the relevant optical network termination unit ONU1...3, such that the minimum guaranteed transmission capacity is once again provided for the relevant ATM connections vCBR1...3, VBRrt, VBRnrt1...x, vGFR1...y, vUBR in the corresponding ATM service class CBR, VBRrt, VBRnrt, GFR, UBR. The transmission resource elements tpr1...3, which were allocated to an optical network termination unit ONU1...3 using the method according to the invention, in the passive optical network PON are in this case increased as a function of the respective ATM service class CBR, VBRrt, VBRnrt, GFR, UFR:

- for ATM connections in the ATM service class CBR - in this case the tolerant class - and in the ATM service class VBRrt, the allocated resource elements tpr1...3 are increased at least to the sum of the "Peak Cell Rate (PCR)" of all the CBR/VBRrt connections,
- for ATM connections in the ATM service class VBRrt, the allocated resource elements tpr1...3 are increased at least to the sum of the "Sustainable Cell Rate (SCR)" for all the VBRnrt connections, and
- for ATM connections in the ATM service class GFR, the allocated resource elements tpr1...3 are increased at least to the sum of the "Minimum Cell Rate (MCR)" for all the GFR connections.

ATM connections in the stringent class - that is to say the ATM connections vCBR1...3 in the non-tolerant ATM service class CBR - are advantageously ignored in the described access control, since ATM connections vCBR1...3

such as these place stringent requirements on the guaranteed minimum transmission bandwidth and compliance with the guaranteed ATM traffic parameters and QoS parameters, which must not be undershot. A connection-specific calculation - also referred to as VC-specific - and allocation of the transmission resource elements tpr1...3 in the passive optical network PON are carried out for ATM connections such as these which are routed via an optical network termination unit ONU1...3 and which pose appropriately stringent requirements on the ATM-specific traffic parameters and QoS parameters, with at least the sum of the guaranteed minimum transmission capacities being reserved for such ATM connections vCBR1...3.

The respective absolute queue filling level fs1...n of the queues WS1...n pointing in the upstream direction is evaluated in a weighted manner by the control unit MAC which is arranged in the optical network monitoring unit OLT, for assignment of transmission resource elements tpr1...3, which are allocated to an optical network termination unit ONU1...3, beyond the guaranteed minimum transmission capacities of the ATM connections vCBR1...3, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR. The weighting factor for the individual ATM service classes CBR, VBR, VBRnrt, GFR, UBR can be configured as required in the optical network monitoring unit OLT.

As already described, the queues WS1...n which are arranged in an optical network termination unit are read in a weighted manner by means of the WFQ scheduler. According to the invention, the weighting factors for the queues WS1...n are matched to the time-division-multiplex-oriented transmission resource elements tpr1...3 which are currently allocated to the optical network termination unit ONU1...3, that is to say they are reduced, in the passive optical network, and their sizes are defined such that the queues for ATM connections vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR in the non-stringent classes are read with the minimum guaranteed transmission capacity below the [lacuna] in each case for the ATM connection. Each queue WS1...n

which is arranged in an optical network termination unit ONU1...3 is advantageously allocated a second upper queue filling level limit value $y_{HIGH}1...s$. The first upper, ATM service class specific queue total filling level limit values $x_{HIGH}1...s$ which are stored in the optical network monitoring unit OLT, and the second connection-specific queue filling level limit values $y_{HIGH}1...s$, which are stored in the optical network termination units ONU1...3, have a fixed relationship with one another. The ratio of these queue limit values y_{HIGH}/x_{HIGH} depends on the frequency with which the queue filling levels fs1...n of the queues WS1...n pointing in the upstream direction are checked, and can be set to the value 1 if the checking frequency is greater than a specific level. If the control unit STG which is arranged in the optical network termination unit ONU1...3 finds that one of the two upper queue filling level limit values $y_{HIGH}1...s$ has been exceeded, then the control unit STG recalculates the weighting factors for the queues WS1...n. The recalculated weighting factors are used for reading the queues WS1...n for the purposes of the minimum transmission capacities guaranteed for the individual ATM connections.

By way of example, a situation can occur in which queue filling level information fs1...n or ATM service class specific queue total filling level information ifs_CBR, ifs_VBRrt, ifs_VBRnrt, ifs_GFR, ifs_UBR which has been corrupted by transmission errors is transmitted by the optical network termination units ONU1...3 to the optical network monitoring unit OLT. This can result in the rate at which the WFQ schedulers are read in the optical network termination units ONU1...3 not matching the time-division-multiplex-oriented resource elements tpr1...3 which are allocated to each optical network termination unit ONU1...3 in the passive optical network PON so that, for example, the guaranteed minimum transmission capacities for those ATM connections in ATM service classes which have a lower priority classification are no longer complied with. In order to prevent possible data losses, the first upper ATM service class specific queue total filling level limit

value $x_{HIGH}1...s$ which is allocated to a queue WS1...n - and which controls the allocation of the transmission resource elements tpr1...3 in the passive optical network PON - is advantageously set to be lower than the associated second upper queue filling level limit value $y_{HIGH}1...s$ - which controls the WFQ scheduler for an optical network termination unit ONU1...3, which makes it possible for the optical network monitoring unit to identify at an early stage that a queue WS1...n is overflowing. When transmission errors occur during transmission of queue filling level information to the optical network monitoring unit OLT, this prevents the optical network monitoring unit OLT from allocating an excessively small extent of transmission resource elements tpr1...3 in the passive optical network PON to the individual optical network termination units ONU1...3, hence making it temporarily impossible to comply with the guaranteed minimum transmission capacities for the ATM connections vCBR1...3, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR which are routed via an optical network termination unit ONU1...3.

According to a further advantageous refinement variant of the method according to the invention - not illustrated - an additional first lower ATM service class specific queue total filling level limit value and a second lower connection-specific queue filling level limit value are provided for each of the queues WS1...n which are arranged in an optical network termination unit ONU1...3, with the transmission resource element tpr1...3 which is allocated to each optical network termination unit ONU1...3 being reduced if the first lower ATM service class specific queue total filling level limit value which is allocated to a queue WS1...n is undershot, and with the rate of reading of the WFQ scheduler being reduced if the second lower connection-specific queue filling level limit value is undershot - for example below the sum of the guaranteed minimum transmission capacities of all the ATM connections vCBR1...3, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR in each case in one ATM service class CBR, VBRrt, VBRnrt, GFR, UBR.

The generation and calculation of the upper and lower ATM service class specific queue total filling level limit values and connection-specific queue filling level limit values can be carried out in a first step by inputting via a network management interface, which is in each case arranged in the optical network termination units ONU1…3 or in the optical network monitoring unit OLT. Alternatively, in particular in the case of complex network configurations, these queue filling level limit values are calculated by an algorithm in the respective optical network termination units ONU1…3 or in the optical network monitoring unit OLT as a function of the ATM traffic parameters for the respective ATM connections vCBR1…3, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR.

The method according to the invention is suitable in particular for subscriber access networks ACCESS in which no signaling functionalities, or only a small number of signaling functionalities, are transmitted to the ATM layer. However, the method according to the invention can also be used for switched virtual connections, or SVC connections. In this situation, the current ATM traffic parameters for the respective ATM connections vCBR1…3, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR must be transmitted to the optical network termination units ONU1…3 and to the optical network monitoring unit OLT.

If the optical network monitoring unit OLT has an "ATM switch" functionality, then the provision of the ATM traffic parameters for the access control unit MAC which is arranged in the optical network monitoring unit OLT must be controlled internally. If the optical network monitoring unit OLT is in the form of an autonomous network element without any SVC functionality, then the ATM traffic parameters can be provided from the higher-level ATM switch via a VB 5.2 interface. For the monitoring function, in which the passive optical network PON is checked for the presence

of sufficient transmission capacity when setting up an ATM connection vCBR1…3, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR, the access control functionality described above is transparent; however, it is not permissible to overbook the minimum guaranteed transmission capacities for the ATM connections vCBR1…3, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR which are routed via the passive optical network PON.

Patent claims

1. A method for matching transmission resources (rpon) between a central and a number of decentralized communications devices (OLT, ONU1…3), in which the central communications device (OLT) allocates a transmission resource element (tpr1…3) to each decentralized communications device (ONU1…3) as a function of the quality and/or transmission characteristics of at least one connection (vCBR, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR) which is routed via the respective transmission resource element (tpr1…3),
characterized
- in that the transmission resource elements (tpr1…3) which are allocated to the decentralized communications devices (ONU1…3) are at least partially reduced,
- in that the quality and/or the transmission characteristics of the at least one connection (vCBR, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR) which is routed via the respective reduced transmission resource element (tpr1…3) is determined, and
- in that the extent of each reduced transmission resource element (tpr1…3) which is allocated to a decentralized communications device (ONU1…3) is modified or retained as a function of the quality.

2. The method as claimed in claim 1,
characterized
in that the transmission resources (rpon) which become free when the allocated transmission resource elements (tpr1…3) are at least partially reduced are provided at least temporarily to other decentralized communications devices (ONU1…3).

3. The method as claimed in claim 1 or 2,
characterized
in that, if it is found that the guaranteed quality and/or the transmission characteristics of at least one of the connections (vCBR, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR) which is routed via the reduced resource element (tpr1…3) allocated to a decentralized communications device (ONU1…3) is not satisfactory, the extent of the allocated, reduced, transmission resource element (tpr1…3) is increased.

4. The method as claimed in one of the preceding claims,
characterized
- in that the at least one connection (vCBR, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR) which is routed via the respective allocated transmission resource element (tpr1…3) is implemented using Asynchronous Transfer Mode ATM, with the ATM connection (vCBR, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR) being configured in accordance with a standardized ATM service class, which in each case specifies the quality and the transmission characteristics of the ATM connection,
- in that the information to be transmitted using an ATM connection (vCBR, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR) is stored in at least one queue (WS1…n) in each decentralized communications device (ONU1…3)
- in that the current queue filling level (fs1…n) of the at least one queue (WS1…n) is recorded and
- in that, by assessing the recording result, the quality and the transmission characteristics of the respective ATM connections (vCBR, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR) are determined, and the allocated transmission resource element (tpr1…3) is modified as a function of the quality and of the transmission characteristics.

5. The method as claimed in claim 4,
characterized
in that the ATM connections (vCBR, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR) are each configured in accordance with the ATM service classes

- Constant Bit Rate (CBR), or
- Variable Bit Rate - real time (VBRrt), or
- Variable Bit Rate - non real time (VBRnrt), or
- Guaranteed Frame Rate (GFR) or
- Unspecified Bit Rate (UBR) or
- in accordance with a further ATM service class defined by the ATM forum,
  in which case the ATM service classes can be allocated to the Quality of Service classes - Class 1, Class 2, Class 3, U Class - as defined in the ITU-T Specification I.356.

6. The method as claimed in claim 4 or 5,
characterized
in that, if there are a number of ATM connections (vCBR, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR) which are routed via a decentralized communications device (ONU1…3), the queue filling levels (fs1…n) of the queues (WS1…n) are recorded and assessed as a function of the ATM service class of the respective ATM connections (vCBR, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR).

7. The method as claimed in one of claims 4 to 6,
characterized

- in that the recording results are transmitted to the central communications device (OLT), and
- in that, in the central communications device (OLT) the transmitted recording results are used to assess the quality and the transmission characteristics of the respective ATM connections (vCBR, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR), and the transmission resource elements (tpr1…3) which are allocated to the decentralized communications devices (ONU1…3)

are modified as a function of the quality and the transmission characteristics.

8. The method as claimed in claims 6 and 7, **characterized**

- in that an ATM service class-specific sum of the queue filling levels of the corresponding queues (WS1...n) is formed for each ATM service class, with the ATM service class specific queue total filling level information (ifs_CBR, ifs_VBRrt, ifs_VBRnrt, ifs_GFR, ifs_UBR) which is formed being weighted as a function of the ATM service classes,
- in that the quality and the transmission characteristics of the ATM connections (vCBR, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR) of an ATM service class are determined by assessing the weighted ATM service class specific queue total filling level information (ifs_CBR, ifs_VBRrt, ifs_VBRnrt, ifs_GFR, ifs_UBR), on an ATM service class specific basis in each case, and the transmission resource element (tpr1...3) which is allocated to the decentralized communications device (ONU1...3) is modified as a function of the quality and the transmission characteristics.

9. The method as claimed in one of claims 4 to 8, **characterized**

- in that the queue filling level information (fs1...n) from ATM connections (vCBR1...3) which are allocated to the stringent class - Class 1 - in accordance with ITU-T I356 are ignored, and
- in that the transmission resource (tpr1...3) which is allocated to a decentralized communications device (ONU1...3) comprises at least the sum of the guaranteed minimum transmission capacity of all the ATM connections (vCBR1...3) which are routed via the

allocated transmission resource (tpr1…3) in the stringent class in accordance with ITU-T I.356.

10. The method as claimed in one of claims 4 to 9, **characterized** in that the transmission resource element (tpr1…3) which is allocated to a decentralized communications device (ONU1…3) is reduced in such a manner that the sum of the guaranteed minimum transmission capacity is undershot for the at least one ATM connection (vCBR, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR) of an ATM service class.

11. The method as claimed in one of claims 4 to 10, **characterized** in that, for each decentralized communications device (ONU1…3),
- a first upper ATM service class specific queue total filling level limit (x_{HIGH}) is defined for each ATM service class specific queue filling level information item (ifs_CBR, ifs_VBRrt, ifs_VBRnrt, ifs_GFR, ifsUBR),
- if it is found that one of the defined first upper queue total filling level limit values (x_{HIGH}) has been exceeded, the transmission resource element (tpr1…3) which is allocated to the decentralized communications device (ONU1…3) is increased in such a manner that it covers at least
-- the sum of the peak cell rate of all the CBR and/or VBRrt connections, and/or
-- the sum of the sustainable cell rate of all the VBRnrt connections, and/or
-- the sum of the minimum cell rate of all the GFR connections.

12. The method as claimed in one of claims 4 to 11, **characterized** in that the queues (WS1…3) which are arranged in a

decentralized communications device (ONU1...3) are read as a function of the ATM service classes of the ATM connections (vCBR, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR), and as a function of the allocated transmission resource element (tpr1...3).

13. The method as claimed in one of claims 4 to 12, **characterized**
in that, when an allocated transmission resource element (tpr1...3) is reduced, in a decentralized communications device (ONU1...3) the individual queues (WS1...n) below the respectively guaranteed minimum transmission capacity of the respective ATM connections (vCBR, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR) are read.

14. The method as claimed in one of claims 4 to 13, **characterized**
in that the queues (WS1...n) which are arranged in a decentralized communications device (ONU1...3) are read using the weighted fair queuing algorithm (WFQ), with
- the queues (WS1...n) each being allocated a weighting factor as a function of the ATM service classes of the respective ATM connections (vCBR, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR), and
- the queues (WS1...n) being read as a function of the allocated weighting factors.

15. The method as claimed in claim 14, **characterized**
in that the reading process based on the weighted fair queuing algorithm (WFQ) has a further reading process based on the absolute delay priority algorithm (ADP), which is designed in accordance with the absolute delay priority algorithm, superimposed on it, by means of which the queues (WS1) for ATM connections in the stringent class are read with priority.

16. The method as claimed in one of claims 4 to 15, **characterized**
in that, in each decentralized communications device (ONU1…3),
- a second upper queue-specific queue filling level limit value (y_{HIGH}) is defined for each queue (WS1…n), and
- if it is found that one of the defined second upper queue filling level limit values (y_{HIGH}) has been exceeded, the weighting factors which are allocated to the queues (WS1…n) of the corresponding ATM connections (vCBR, vVBRrt, vVBRnrt1…x, vGFR1…y, vUBR) are recalculated.

17. The method as claimed in one of the preceding claims,
characterized
- in that the transmission resources (rpon) are provided by a passive optical communications network (PON), with the central communications device (OLT) being in the form of an optical network monitoring unit and the decentralized communications devices (ONU1…3) being in the form of optical network termination units,
- in that the transmission resource elements (tpr1…3) which are allocated to the decentralized communications devices (ONU1…3) are time-division-multiplex-oriented, and
- in that the access from the passive optical communications network (PON) to the decentralized communications devices (ONU1…3) is allocated using a TDMA access method.

18. The method as claimed in one of claims 1 to 16, **characterized**
in that the transmission resources (rpon) are provided within an SDH or SONET ring.

19. A communications arrangement (ACCESS) having a central and a number of decentralized

communications devices (OLT, ONU1...3), and having a transmission medium (PON) which is arranged between the central and the decentralized communications devices (OLT, ONU1...3) and has transmission resources (rpon).

having a control unit (MAC), which is arranged in the central communications device (OLT), for allocation of transmission resource elements (tpr1...3) to the decentralized communications devices (ONU1...3), in each case as a function of the quality and/or the transmission characteristics of at least one connection (vCBR, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR), which is routed via the respective transmission resource element (tpr1...3),

characterized

- in that the control unit (MAC) is designed such that the transmission resource elements (tpr1...3) which are allocated to the decentralized communications devices (ONU1...3) are at least partially reduced,
- in that the decentralized communications devices (ONU1...3) have
  - -- recording means for recording the quality and/or the transmission characteristics of the at least one connection (vCBR, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR) which is routed via the reduced transmission resource element (tpr1...3), and
  - -- means for transmitting the recording result to the central communications device (OLT), and
- in that the control unit (MAC) has modification means using which the extent of the reduced transmission resource element (tpr1...3) which is allocated to each decentralized communications device (ONU1...3) is modified or retained as a function of the recording result.

20. The communications arrangement as claimed in claim 19,

characterized

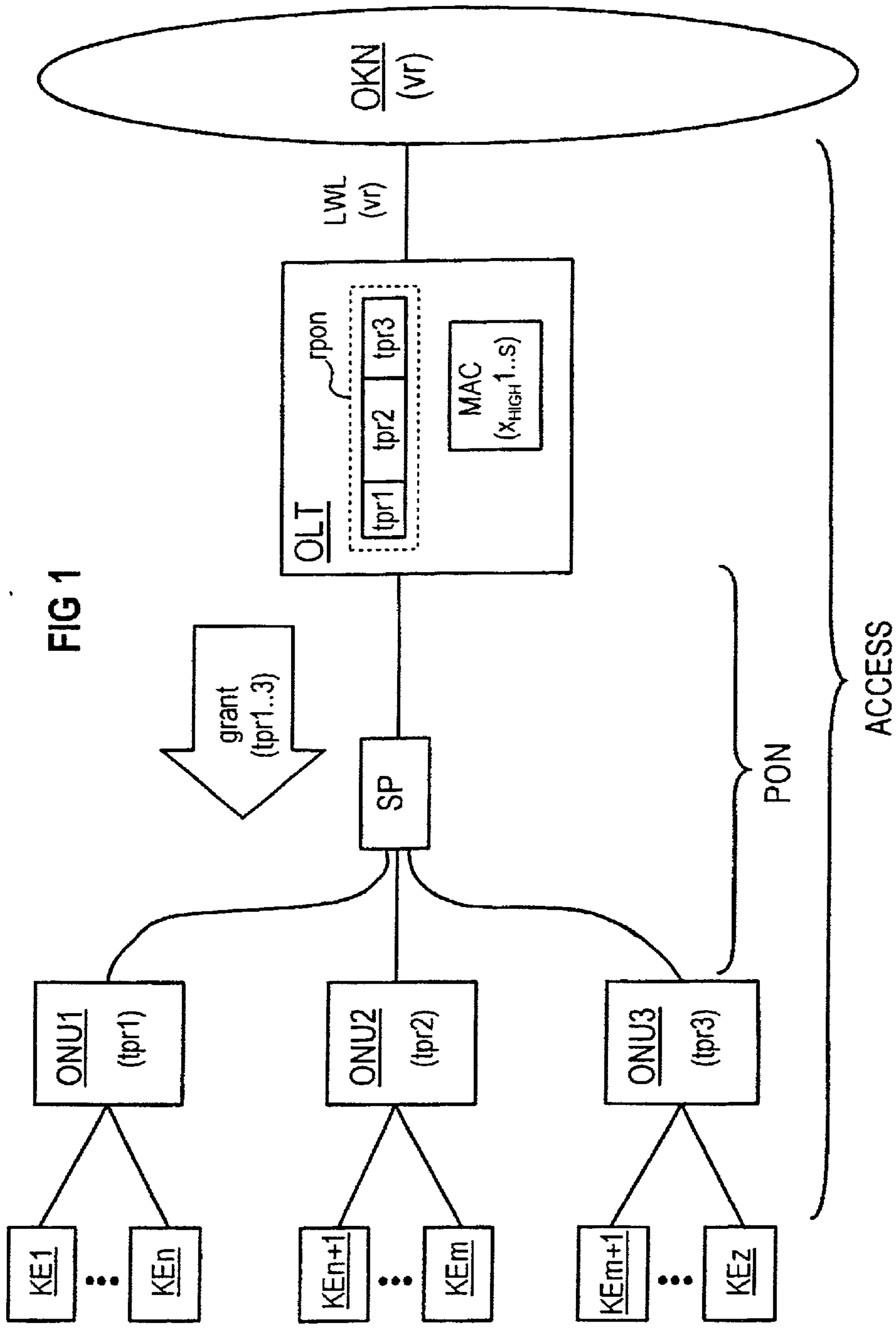
in that the modification means are designed such that, if it is found that the quality and/or the transmission characteristics of at least one of the connections (vCBR, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR) which is routed via the reduced resource element (tprl...3) which is allocated to a decentralized communications device (ONU1...3) is not sufficient, the extent of the respectively allocated, reduced transmission resource element (tpr1...3) is increased.

21. The communications arrangement as claimed in claim 20,

characterized

- in that the at least one connection (vCBR, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR) which is routed via the allocated transmission resource element (tpr1...3) is implemented using Asynchronous Transfer Mode ATM, with the ATM connection (vCBR, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR) being configured in accordance with an ATM service class defined by the ATM forum, which in each case specifies the quality and the transmission characteristics of the ATM connection,
- in that at least one queue (WS1...n) is provided in each decentralized communications device (ONU1...3) for temporary storage of the information to be transmitted in the at least one ATM connection (vCBR, vVBRrt, vVBRnrt1...x, vGFR1...y, vUBR),
- in that each decentralized communications device (ONU1...3) has filling level recording means for recording the current queue filling level (fs1...n) of the at least one queue (WS1...n) and for transmitting the recording result to the control unit (MAC) which is arranged in the central communications device (OLT), and
- in that the control unit (MAC) is designed such

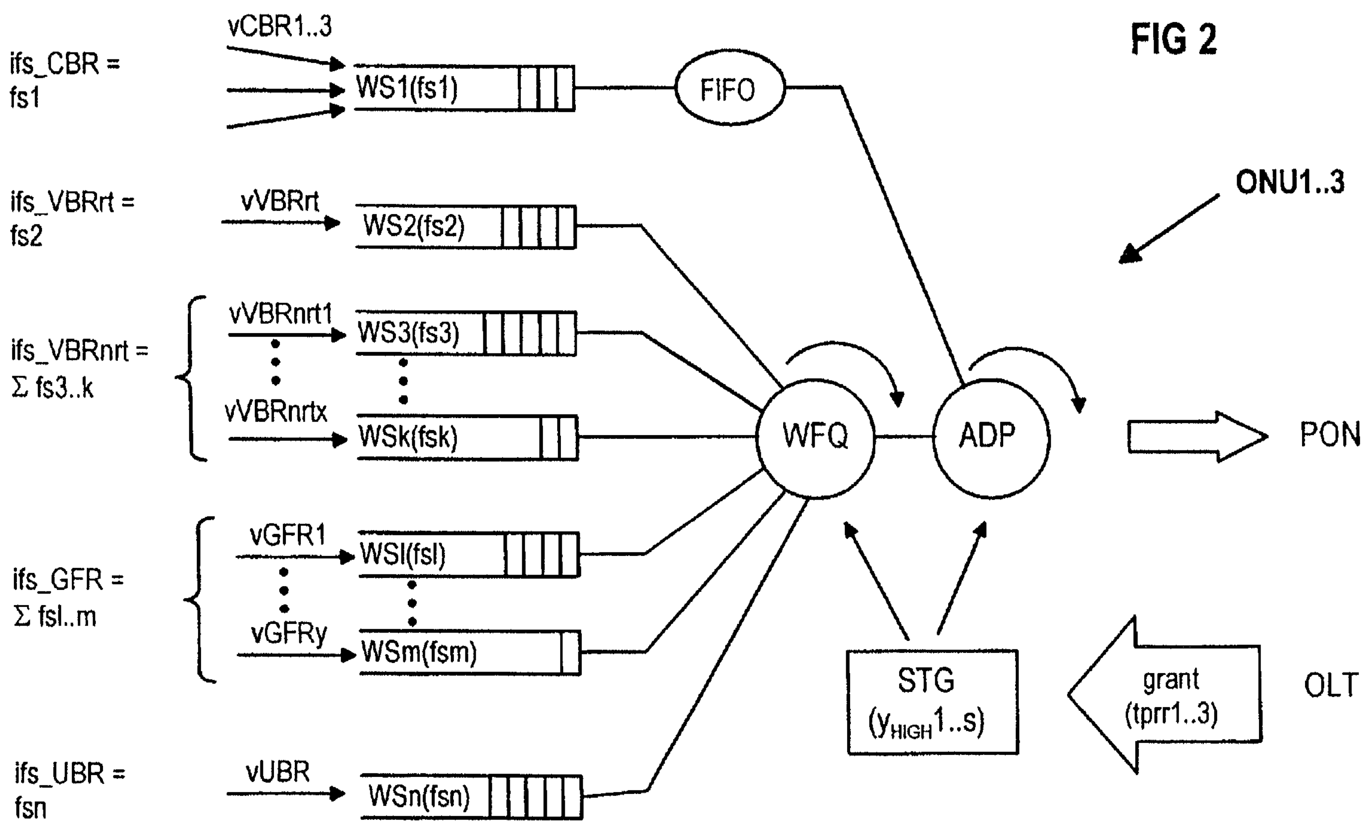
that the quality and the transmission charasteristics of the respective ATM connections (vCBR, vVBRrt, vVBRnrt1…x), vGFR1…y, vUBR) are determined by assessing the transmitted recording results, and the transmission results, and the transmission resource elements (tpr1…3) which are allocated to the decentralized communications devices (ONU1…3) are modified as a function of the quality and the transmission characteristics.



OKN
(vr)
LWL
(vr)
OLT
rpon
tpr1
tpr2
tpr3
MAC
(x_{HIGH}1..s)
grant
(tpr1..3)
SP
PON
ACCESS
ONU1
(tpr1)
ONU2
(tpr2)
ONU3
(tpr3)
KE1
KEn
KEn+1
KEm
KEm+1
KEz

FIG 1

FIG 2


ifs_CBR =
fs1
vCBR1..3
WS1(fs1)
FIFO
ifs_VBRrt =
fs2
vVBRrt
WS2(fs2)
ifs_VBRnrt =
Σ fs3..k
vVBRnrt1
WS3(fs3)
vVBRnrtx
WSk(fsk)
ifs_GFR =
Σ fsl..m
vGFR1
WSl(fsl)
vGFRy
WSm(fsm)
ifs_UBR =
fsn
vUBR
WSn(fsn)
WFQ
ADP
STG
(yHIGH1..s)
ONU1..3
PON
grant
(tprr1..3)
OLT

Declaration and Power of Attorney For Patent Application
Erklärung Für Patentanmeldungen Mit Vollmacht
German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

As a below named inventor, I hereby declare that:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

My residence, post office address and citizenship are as stated below next to my name,

dass ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Verfahren und Kommunikationsanordnung zur Anpassung von übertragungstechnischen Ressourcen zwischen einer zentralen und mehreren dezentralen Kommunikationseinrichtungen.

Method and communication system for modifying transmission resources between a central communication device and several decentralised communication devices

deren Beschreibung

(zutreffendes ankreuzen)
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PCT Anmeldungsnummer PCT/DE00/02132
eingereicht wurde und am ______
abgeändert wurde (falls tatsächlich abgeändert).

the specification of which

(check one)
☐ is attached hereto.
☒ was filed on 30.06.2000 as
PCT international application
PCT Application No. PCT/DE00/02132
and was amended on ________
(if applicable)

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

IDNR: 2590 / V: 99-1.00 / B:Val

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Prior foreign appplications
Priorität beansprucht

Priority Claimed

19930228.6 (Number) (Nummer)	DE (Country) (Land)	30.06.1999 (Day Month Year Filed) (Tag Monat Jahr eingereicht)	☒ Yes Ja	☐ No Nein
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	☐ Yes Ja	☐ No Nein
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	☐ Yes Ja	☐ No Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozeßordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35. United States Code. §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occured between the filing date of the prior application and the national or PCT international filing date of this application.

PCT/DE00/02132 (Application Serial No.) (Anmeldeseriennummer)	30.06.2000 (Filing Date D, M, Y) (Anmeldedatum T, M, J)	anhängig (Status) (patentiert, anhängig, aufgegeben)	pending (Status) (patented, pending, abandoned)
(Application Serial No.) (Anmeldeseriennummer)	(Filing Date D,M,Y) (Anmeldedatum T, M; J)	(Status) (patentiert, anhängig, aufgeben)	(Status) (patented, pending, abandoned)

Ich erkläre hiermit, dass alle von mir in der vorliegenden Erklärung gemachten Angaben nach meinem besten Wissen und Gewissen der vollen Wahrheit entsprechen, und dass ich diese eidesstattliche Erklärung in Kenntnis dessen abgebe, dass wissentlich und vorsätzlich falsche Angaben gemäss Paragraph 1001, Absatz 18 der Zivilprozessordnung der Vereinigten Staaten von Amerika mit Geldstrafe belegt und/oder Gefängnis bestraft werden koennen, und dass derartig wissentlich und vorsätzlich falsche Angaben die Gültigkeit der vorliegenden Patentanmeldung oder eines darauf erteilten Patentes gefährden können.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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VERTRETUNGSVOLLMACHT: Als benannter Erfinder beauftrage ich hiermit den nachstehend benannten Patentanwalt (oder die nachstehend benannten Patentanwälte) und/oder Patent-Agenten mit der Verfolgung der vorliegenden Patentanmeldung sowie mit der Abwicklung aller damit verbundenen Geschäfte vor dem Patent- und Warenzeichenamt: *(Name und Registrationsnummer anführen)*

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

And I hereby appoint

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(Supply similar information and signature for third and subsequent joint inventors).